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[AU/AU]; 1 Cudgen Road, Cudgen, New South Wales 2487 (AU).

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(71) Applicant (for all designated States except US): **A & B HYDROPONICS INTERNATIONAL PTY LTD**
[AU/AU]; Lot 1, Cudgen Road, Cudgen, New South Wales 2487 (AU).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **AGIUS, Joseph**

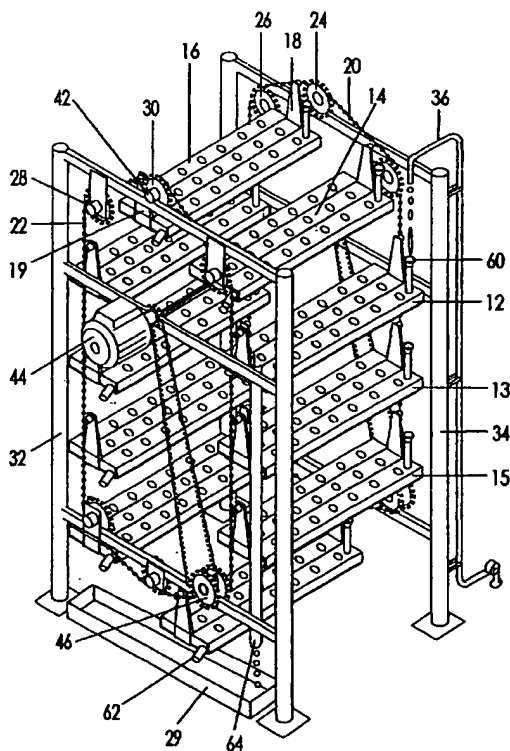
(74) Agent: **PIPERS PATENT AND TRADE MARK ATTORNEYS, BRISBANE**; PO Box 160, Suite 1, Coronation Place, 10 Benson Street, Toowong, Queensland 4066 (AU).

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(54) Title: **A HYDROPONIC APPARATUS**



(57) Abstract: A hydroponic apparatus comprising: (a) troughs (12, 13, 14, 15, 16) linked together to form a continuous track located on guide wheel members (24, 26, 28, 30) in a support frame (32, 34), (b) a liquid supply means (36) to supply liquid to the troughs (12-16), wherein, in operation, the addition of liquid to one/some of the troughs (12-16) alters the weight distribution of the troughs (12-16) causing the track to move on the guide wheel members (24, 26, 28, 30) and thus allowing the troughs (12-16) which have become lighter as liquid is consumed by the plants and/or is lost through evaporation to move into position to be replenished with liquid. This movement is a continuous cycle according to changes in the weight distribution of the troughs (12-16) as liquid is being consumed and replenished.

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Declaration under Rule 4.17:

— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A HYDROPONIC APPARATUS

The invention is described in the following statement:

A HYDROPONIC APPARATUS

FIELD OF THE INVENTION

This invention relates to agricultural devices in particular but not limited to a rotating hydroponic apparatus.

BACKGROUND OF THE INVENTION

Hydroponic methods of growing plants in particular food crops are well known. Problems associated with prior art hydroponic apparatus include regular replenishment of liquid and notwithstanding that hydroponic apparatus enable plants to be grown without soil, such apparatus often requires space and depending on the crop, hot-housed. In conditions where resources and land are expensive, for example, Japan, the added costs of building hothouses, heating, electricity, materials and labour can contribute to make the overall cost of growing crops hydroponically a prohibitively expensive exercise. There are other problems such as positioning the apparatus so that the plants receive uniform exposure to light to produce consistent yields. This can present a problem where hydroponic systems are not easy to move or are permanent fixtures.

OBJECT OF THE INVENTION

It is therefore an object of the present invention to address some of the disadvantages of prior art hydroponic apparatus or to at least provide the public with a useful choice.

STATEMENT OF THE INVENTION

According to one aspect, the invention resides in a hydroponic apparatus including in combination,

a plurality of growing troughs adapted for hydroponic growing of plants;

linking means adapted to link the troughs together in substantially parallel and sequential configuration to form a continuous track;

support means adapted to support and enable movement of the track on the support means;

5 liquid supply means adapted to supply liquid to one or more troughs, wherein in operation, addition of liquid alters the weight distribution of the troughs causing the track to move on the support means, wherein troughs previously supplied with liquid which have become lighter as liquid is consumed by the plants and/or is lost through evaporation, are moved into position to be replenished with liquid in a continuous
10 cycle according to changes to the weight distribution of the troughs as liquid is being consumed and replenished.

Preferably the growing troughs are elongate U-shaped or V-shaped members with a wall at either end. Troughs with a square or rectangular cross-section can also be used.

15 Preferably the troughs are single troughs, however, in an alternative version can be replaced by a pair (or more) of smaller troughs in juxtaposed or side by side position.

Preferably the troughs are made from PVC or other equally suitable material.

Preferably the linking means is a flexible or an articulated linkage means
20 typically chains with connecting members adapted to connect each trough to the linking means to form a loop or continuous track.

Preferably the support means is a freely rotating set of one or more pairs of opposed guide wheel members supported in a support frame, the guide wheel members having guide means adapted to guide the linking means wherein the

troughs are always suspended in a vertical position irrespective of the position of the troughs or track on the support means.

Preferably the liquid supply means is a trickle flow means which trickles liquid into the troughs as each trough passes under the trickle flow means.

5 Preferably the flow of liquid of the liquid supply means can be increased or decreased to control the rate at which the track moves on the support means and also determines the frequency at which liquid is replenished in each trough.

Preferably excess liquid from each trough flows into a trough located below it. In the alternative excess liquid from each trough flows into a downpipe connected
10 to a bottom catchment trough wherein the liquid can be recycled.

Preferably the liquid is water which is added to nutrients in the troughs, however, other liquids containing dissolved nutrients can also be supplied.

Optionally, a small motor can be used to control the rate of moving the track on the support means so that the troughs can be replenished with liquid more
15 frequently.

In another aspect, the invention resides in a method of growing plants hydroponically using the apparatus as herein described including the steps of:

planting plants in a plurality of hydroponic growing troughs linked together to form a continuous track supported on a supporting means adapted to enable
20 movement of the track,

supplying liquid to one or more of the troughs wherein the addition of liquid alters the weight distribution of the troughs causing the track to move on the support means and wherein, troughs previously supplied with liquid become lighter as liquid is consumed by the plants and/or is lost through evaporation are moved into position

to be replenished with liquid in a continuous cycle according to changes to the weight distribution of the troughs as liquid is being consumed and replenished.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention be more readily understood and put into practical effect, reference will now be made to the accompanying illustrations wherein:

Figure 1 is a perspective drawing of the invention according to Example 1;

Figures 1a and 1c show side elevations of the invention of Figure 1;

Figure 1b shows an end elevation of the invention of Figure 1; and

Figure 2 shows a preferred trough assembly of the invention according to Example 2.

DETAILED DESCRIPTION OF THE DRAWINGS

Figures 1, 1a, 1b and 1c show perspective, side elevation and end elevation views of a preferred embodiment of the invention according to Example 1. The hydroponic apparatus 10 preferably comprises twenty troughs 12,14,16 of PVC material. Each trough is preferably four metres or six metres long and is supported each end by aluminum, stainless steel or galvanised steel connecting frame members 18,19 to a pair of continuous linking chains 20,22. The troughs are spaced preferably at intervals of approximately 400 mm apart. The chains and the troughs together form a continuous track which is supported by guide wheels for example shown numbered 24,26,28,30. The guide wheels are mounted in a vertical support frame 32,34 preferably of boxed steel construction. The guide wheels are suitably grooved to guide the chains as each trough passes under the liquid supply means 36 in the form of polypipe at the top of the support frame. Liquid, preferably water, flowing into trough 12 via funnel member 60 causes it to descend under its own weight so that the next trough 14 is positioned under the liquid supply means.

Preferably there are outlets 62 at the bottom of each trough wherein liquid flowing along the troughs can drain into the trough below. In the alternative, liquid does not drain into the catchment trough but flows directly into a downpipe 64 connected to the catchment trough 29 wherein it can be recycled. Preferably the troughs are

5 slightly inclined downwards from where the liquid is supplied by the polypipe 36 so that it flows along the trough before draining through each trough outlet. Preferably there is a bottom catchment trough 29 to catch excess liquid from a downpipe or liquid flowing from the trough outlets which can be recirculated. As liquid is consumed by plants 50,52,54 and/or is lost through evaporation in previously and

10 less recently watered troughs 13,15, the imbalance in the weight distribution contributes to the rotation of the track on the guide wheels in the direction of arrows 40,41 so that each trough is replenished with water in a continuous cycle. The frequency rate at which each trough passes under the liquid supply means is proportionally related to the flow of liquid trickling into the troughs. Guide wheels

15 24,26 are supported on a polished steel axle 42 which is connected to small electric motor 44 associated with a reduction gearbox assembly 46. The motor can be used to drive the guide wheels via the steel axle to cause the rotation of the track and to shorten the time before successive troughs are replenished with liquid. It will be obvious that the speed at which the track rotates on the guide wheels and hence the

20 rate, at which the troughs are replenished with liquid, can be controlled by varying the flow of the liquid supply and/or the speed of the electric motor.

Figure 2 shows detail of a preferred trough assembly according to Example 2. In place of a funnel member (60 in Figures 1, 1a, 1b and 1c) there is shown a drip receptacle 70 to catch liquid dripped from the liquid supply means (36 in Figure 1).

The drip receptacle has holes 70a, 70b and 70c to allow liquid to flow into the individual trough members 16.

ADVANTAGES

The advantages of the present invention include the ability to provide yields
5 of hydroponically grown crops far in excess of traditional hydroponic apparatus of a fixed or permanent design. The inventor who has traveled extensively has visited countries where land and resources are very expensive for example, Japan, and has discovered that the present invention can produce nine to ten times the yield of crops grown in soil by traditional methods for a given area of land. As an example,
10 equivalent crop production from 10,016 square meters of land area under hothouse conditions can be achieved with the invention in only 848 square meters of land. This amounts to a saving of up to 91% of land costs in addition to savings with respect to electricity, heating, materials and labour normally associated with large scale hothouse production.

15 In summary, the benefits of the invention can be listed as follows:

- Large amount of capital is saved by securing a small parcel of land, approximately 1/10th is all that is required.
- In turn, money will also be saved in building a hothouse approximately 1/10th the size to accommodate the present invention.
- 20 • Costs of electricity, heating, labour and certain material can be saved due to the reduced size of the hothouse which also allows for better management in general.
- The design of the invention does not restrict the size or height of a person working with it as each rotating trough will eventually be within reach so
25 that that person can then work in a more comfortable environment by not

having to stretch too high or bend too low thereby reducing also the potential for injury and accidents.

VARIATIONS

It will of course be realised that while the foregoing has been given by way of
5 illustrative example of this invention, all such and other modifications and variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of this invention as is herein set forth.

Throughout the description and claims this specification the word "comprise" and variations of that word such as "comprises" and "comprising", are not intended to
10 exclude other additives, components, integers or steps.

CLAIMS:

1. A hydroponic apparatus including in combination a plurality of growing troughs adapted for hydroponic growing of plants, linking means adapted to link the troughs together in substantially parallel and sequential configuration
5 to form a continuous track, support means adapted to support and enable movement of the track on the support means, liquid supply means adapted to supply liquid to one or more troughs, wherein in operation, addition of liquid alters the weight distribution of the troughs causing the track to move on the support means, wherein troughs previously supplied with liquid which
10 have become lighter as liquid is consumed by the plants and/or is lost through evaporation, are moved into position to be replenished with liquid in a continuous cycle according to changes to the weight distribution of the troughs as liquid is being consumed and replenished.
- 15 2. A hydroponic apparatus as claimed in claim 1, wherein the linking means is a flexible or an articulated linkage means typically chains with connecting members adapted to connect each trough to the linking means to form a loop or continuous track..
- 20 3. A hydroponic apparatus as claimed in claim 1, wherein the support means is a freely rotating set of one or more pairs of opposed guide wheel members supported in a support frame, the guide wheel members having guide means adapted to guide the linking means wherein the troughs are always
25 suspended in a vertical position irrespective of the position of the troughs or track on the support means.

4. A hydroponic apparatus as claimed in any one of the abovementioned claims, wherein the liquid supply means is a trickle flow means which trickles liquid into the troughs as each trough passes under the trickle flow means.
- 5 5. A hydroponic apparatus as claimed in claim 4, wherein the flow of liquid of the liquid supply means can be increased or decreased to control the rate at which the track moves on the support means and also determines the frequency at which liquid is replenished in each trough.
- 10 6. A hydroponic apparatus as claimed in any one of the abovementioned claims wherein excess liquid from each trough flows into a trough below it.
- 7 7. A hydroponic apparatus as claimed in any one of the claims 1 – 5 wherein excess liquid from each trough flows into a downpipe connected to a catchment trough wherein the liquid can be recycled.
- 15 8. A hydroponic apparatus as claimed in any one of the abovementioned claims, wherein the liquid is water which is added to nutrients in the troughs.
- 20 9. A hydroponic apparatus as claimed in any one of claims 1 - 7, wherein the liquid is a liquid other than water and contains dissolved nutrients.
10. A hydroponic apparatus as claimed in any one of the abovementioned claims, wherein a small motor can be used to control the rate of moving the

track on the support means so that the troughs can be replenished with liquid more frequently.

11. A hydroponic apparatus as claimed in any one of the abovementioned
5 claims, wherein the growing troughs are elongate U-shaped or V-shaped members with a wall at either end.

12. A hydroponic apparatus as claimed in any one of claims 1 - 10, wherein the
10 growing troughs have a square or rectangular cross-section with a wall at either end.

13. A hydroponic apparatus as claimed in any one of the abovementioned claims wherein the troughs are single troughs.

14. A hydroponic apparatus as described in any one of the claims 1 - 12 wherein
15 the troughs can be replaced by two or more smaller troughs in juxtaposed or side by side position.

15. A hydroponic apparatus as claimed in any one of the abovementioned
20 claims, wherein the troughs are made from PVC or other suitably inert material.

16. In another aspect the hydroponic apparatus resides in a method of growing
25 plants hydroponically using the apparatus as herein described including the steps of:

planting plants in a plurality of hydroponic growing troughs linked together to form a continuous track supported on a supporting means adapted to enable movement of the track,

supplying liquid to one or more of the troughs wherein the addition of liquid alters the weight distribution of the troughs causing the track to move on the support means and wherein, troughs previously supplied with liquid become lighter as liquid is consumed by the plants and/or is lost through evaporation are moved into position to be replenished with liquid in a continuous cycle according to changes to the weight distribution of the troughs as liquid is being consumed and replenished.

17. A hydroponic apparatus as claimed in any one of the abovementioned claims substantially as herein described with reference to any one of the accompanying drawings.

18. A method of growing plants hydroponically using the apparatus substantially as herein described with reference to any one of the accompanying drawings.

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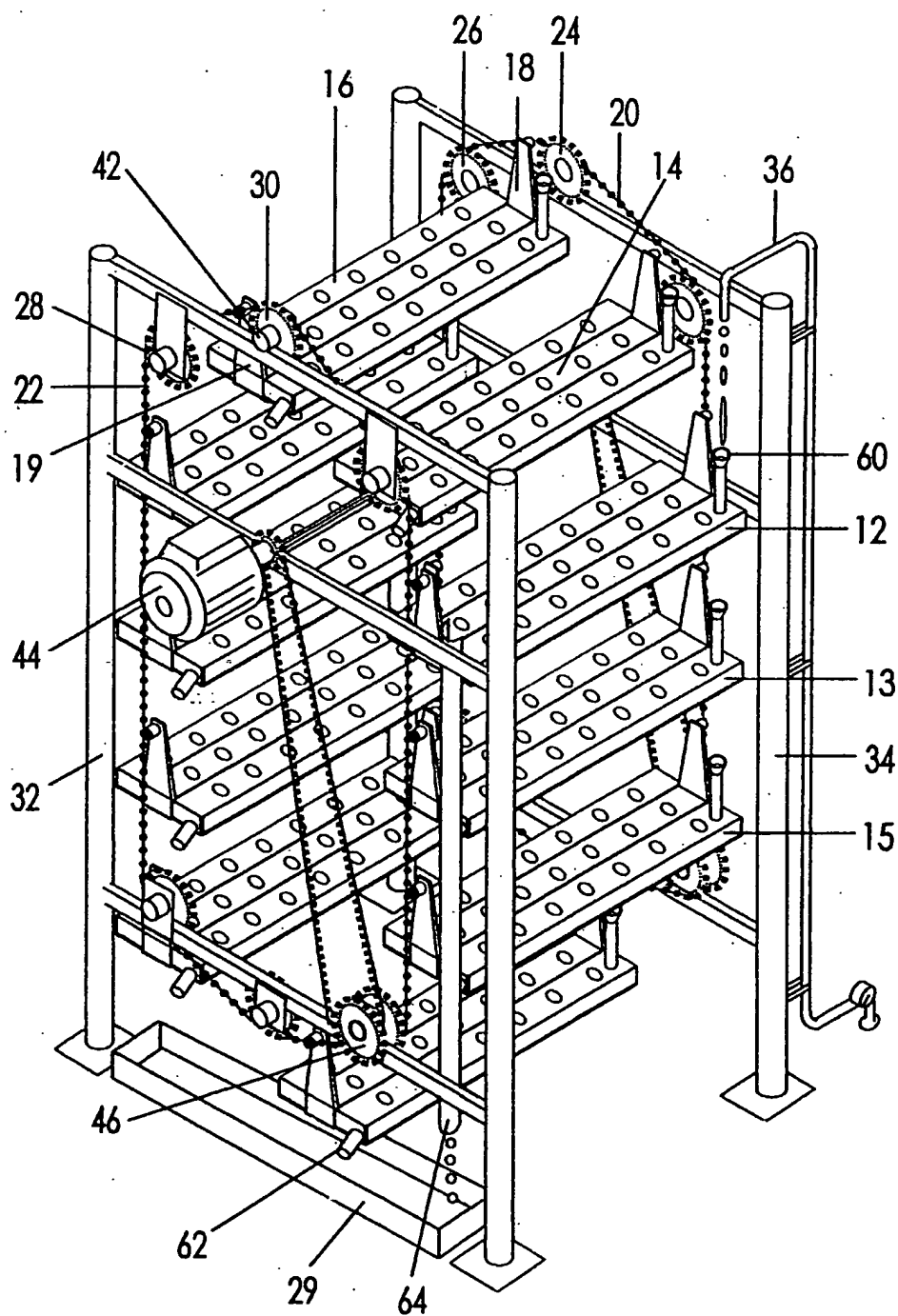
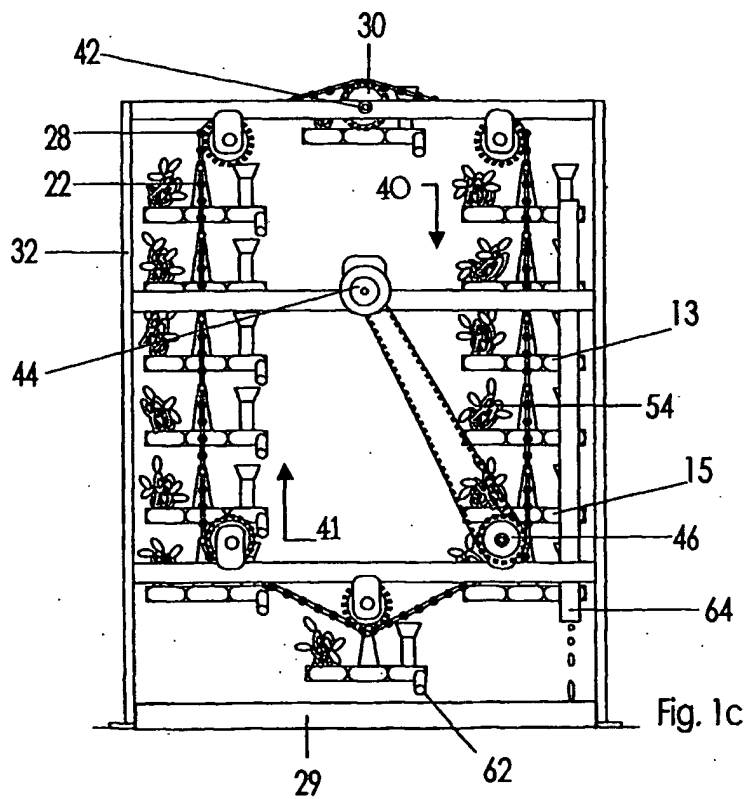
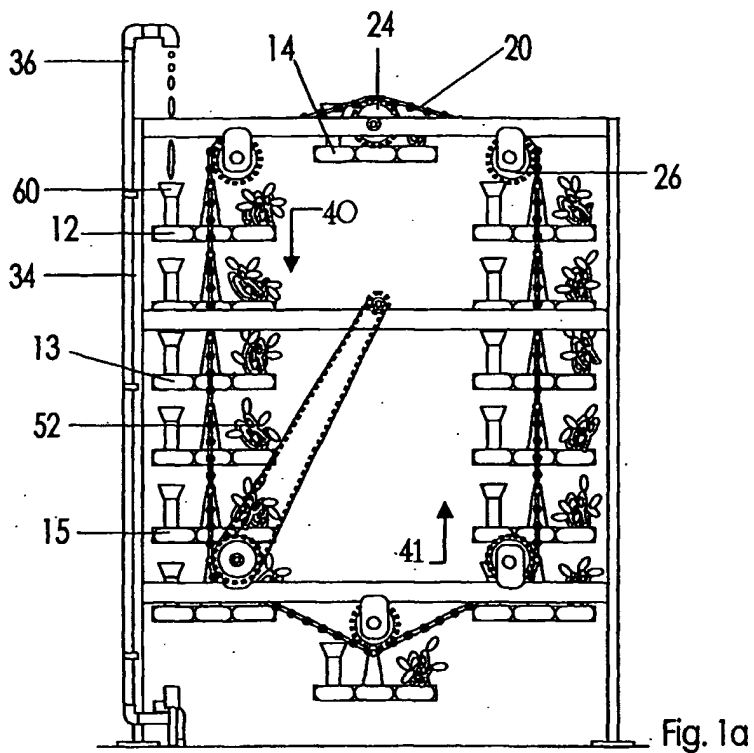


Fig. 1

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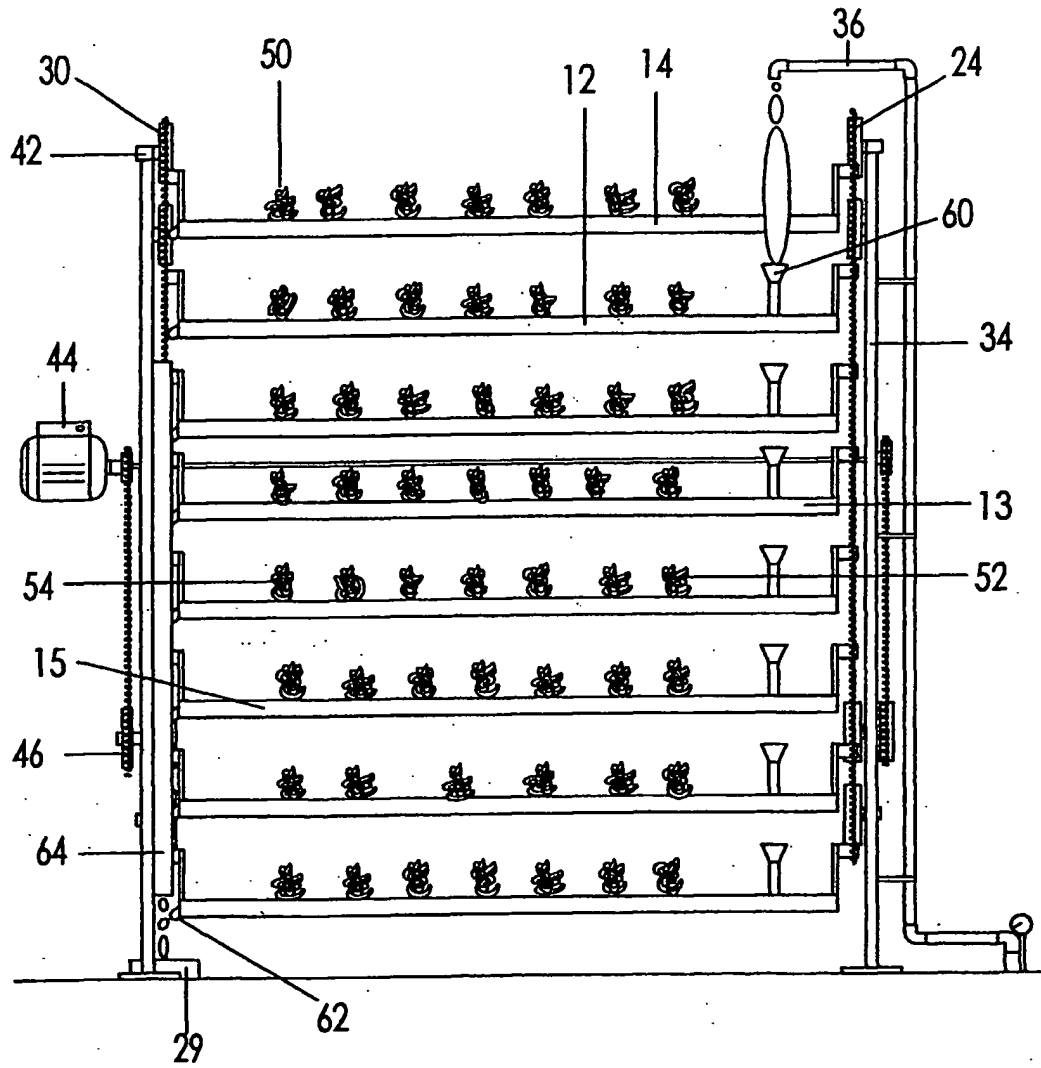


Fig. 1b

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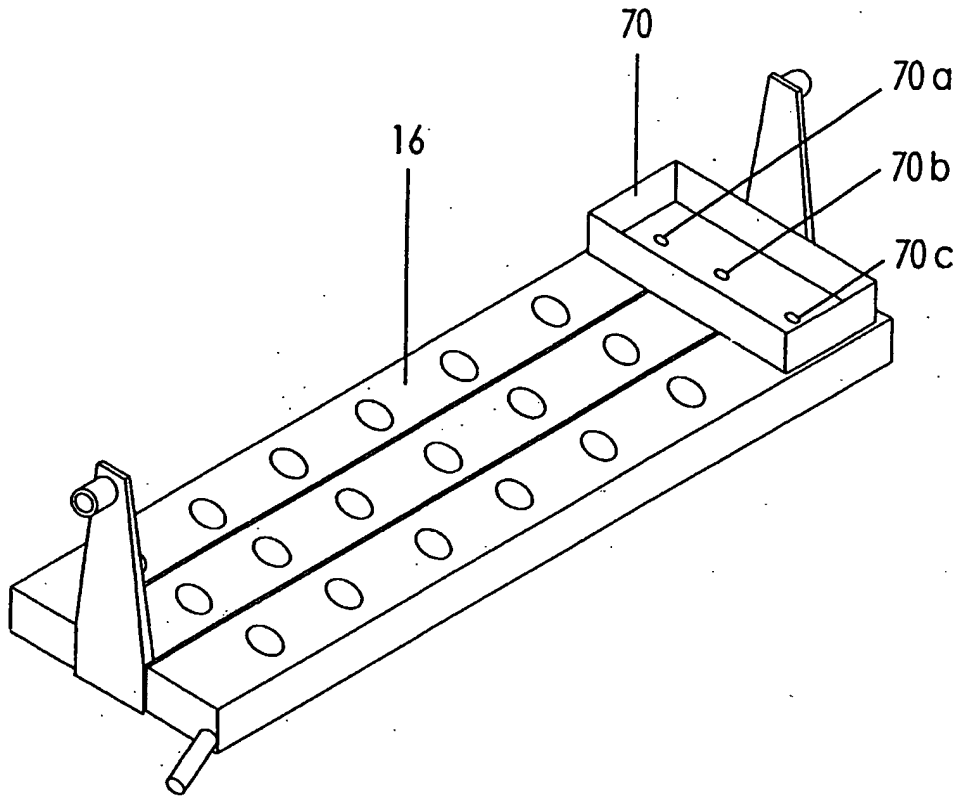


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU02/00097

A. CLASSIFICATION OF SUBJECT MATTER																						
Int. Cl. ⁷ : A01G 31/06																						
According to International Patent Classification (IPC) or to both national classification and IPC																						
B. FIELDS SEARCHED																						
Minimum documentation searched (classification system followed by classification symbols)																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) DWPI, US and EP databases with keywords [eg A01G 31 (all), A01G 9/24, water, trough]																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
A	Derwent Abstract Accession No. 93-065376/08, Class P13, SU 1722301 A1 (BOZHOK) 30 March 1992 Entire document	1-18																				
A	FR 2345912 A (CUVILLIER) 28 October 1977 Entire document	1-18																				
A	US 3909978 A (FLEMING) 7 October 1975 Entire document	1-18																				
<input type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex																						
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A"</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T"</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E"</td> <td>earlier application or patent but published on or after the international filing date</td> <td>"X"</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L"</td> <td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y"</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O"</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> <td>"&"</td> <td>document member of the same patent family</td> </tr> <tr> <td>"P"</td> <td>document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family	"P"	document published prior to the international filing date but later than the priority date claimed		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																			
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Date of the actual completion of the international search 19 February 2002		Date of mailing of the international search report - 1 MAR 2002																				
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU02/00097

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
FR	2345912	NONE			
US	3909978	CA	1020750	DE	2526298
		JP	51013653	NL	7506899
					GB 1465257
					END OF ANNEX